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(54) **MATERIAL PROCESSING PLANT**

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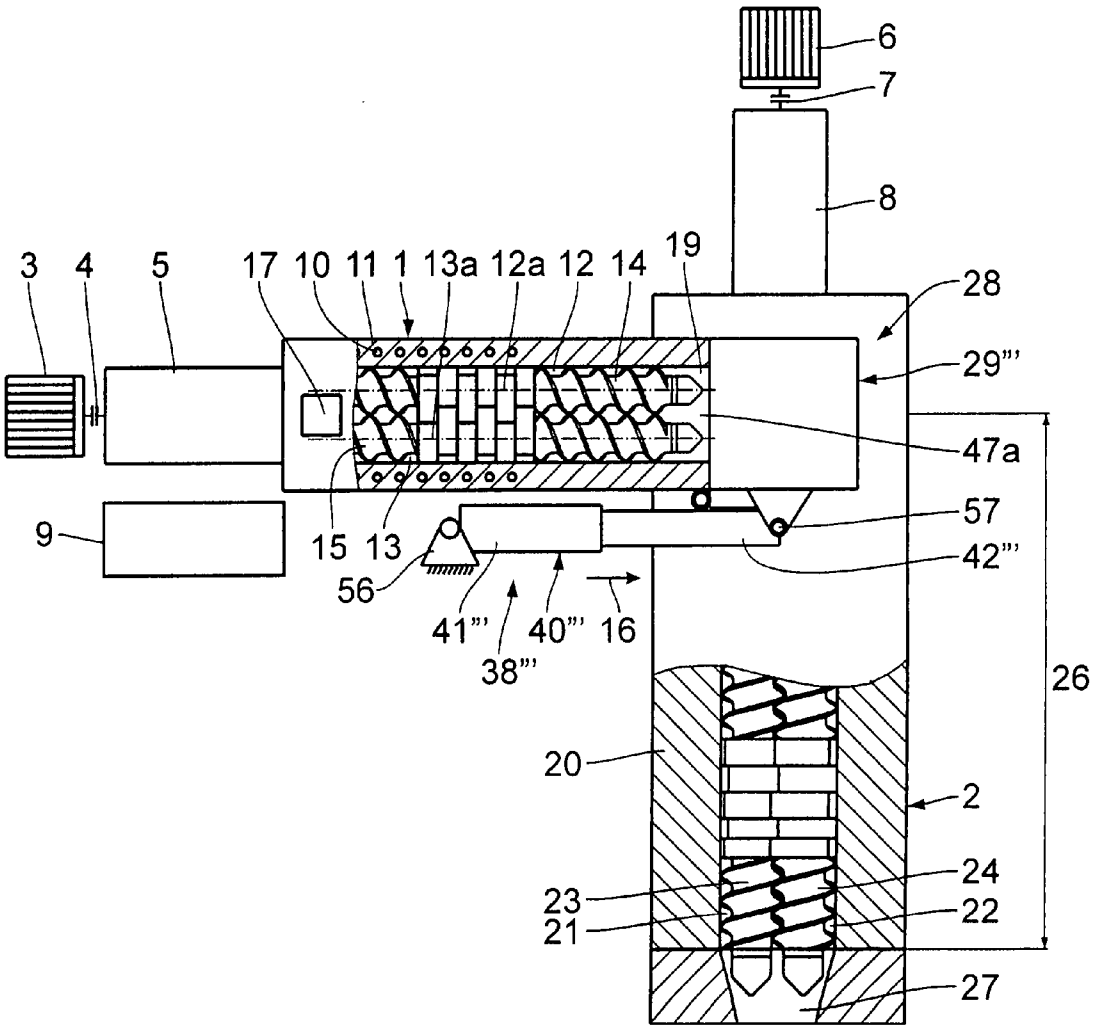
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(57) **ABSTRACT**

A material processing plant comprises two screw-type extruding machines (**1,2**) which are interconnected by means of a link (**29**). The link (**29**) is movable from a position of connection into an open position of release of the casing bores (**12**). Provision is further made for a mover (**38**) which acts on the link (**29**) for implementation of the motion.



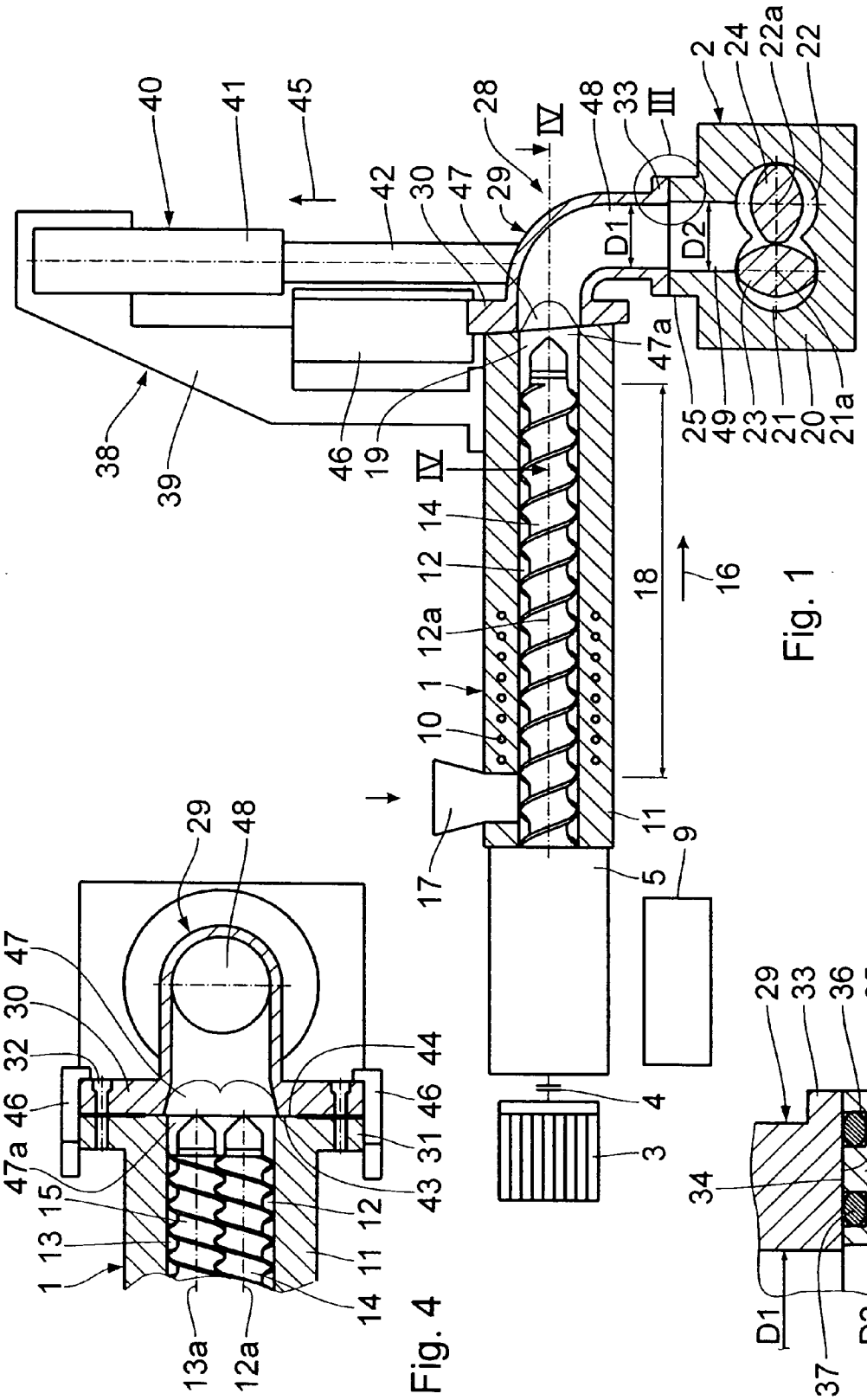


Fig. 1

Fig. 4

Fig. 3

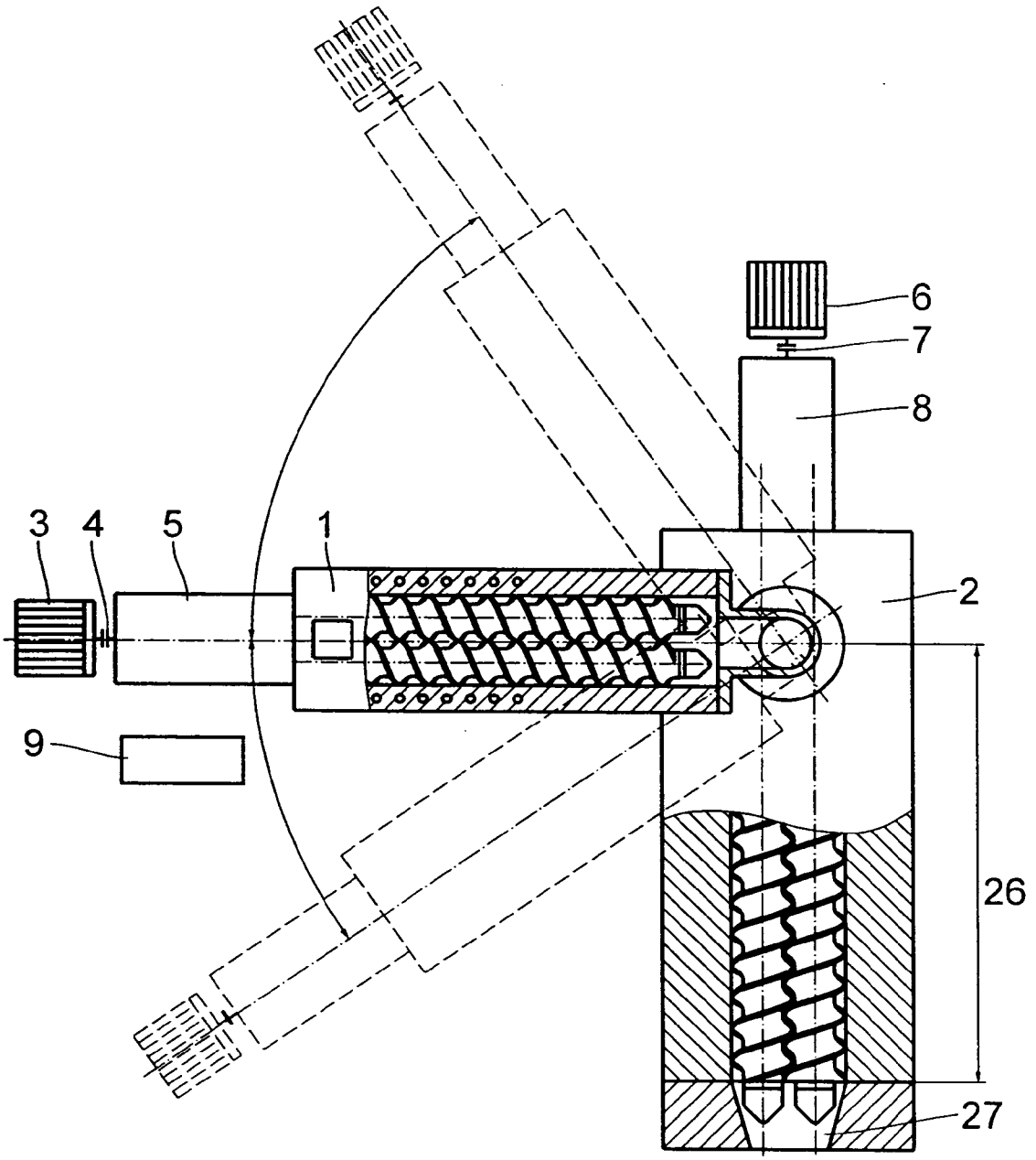


Fig. 2

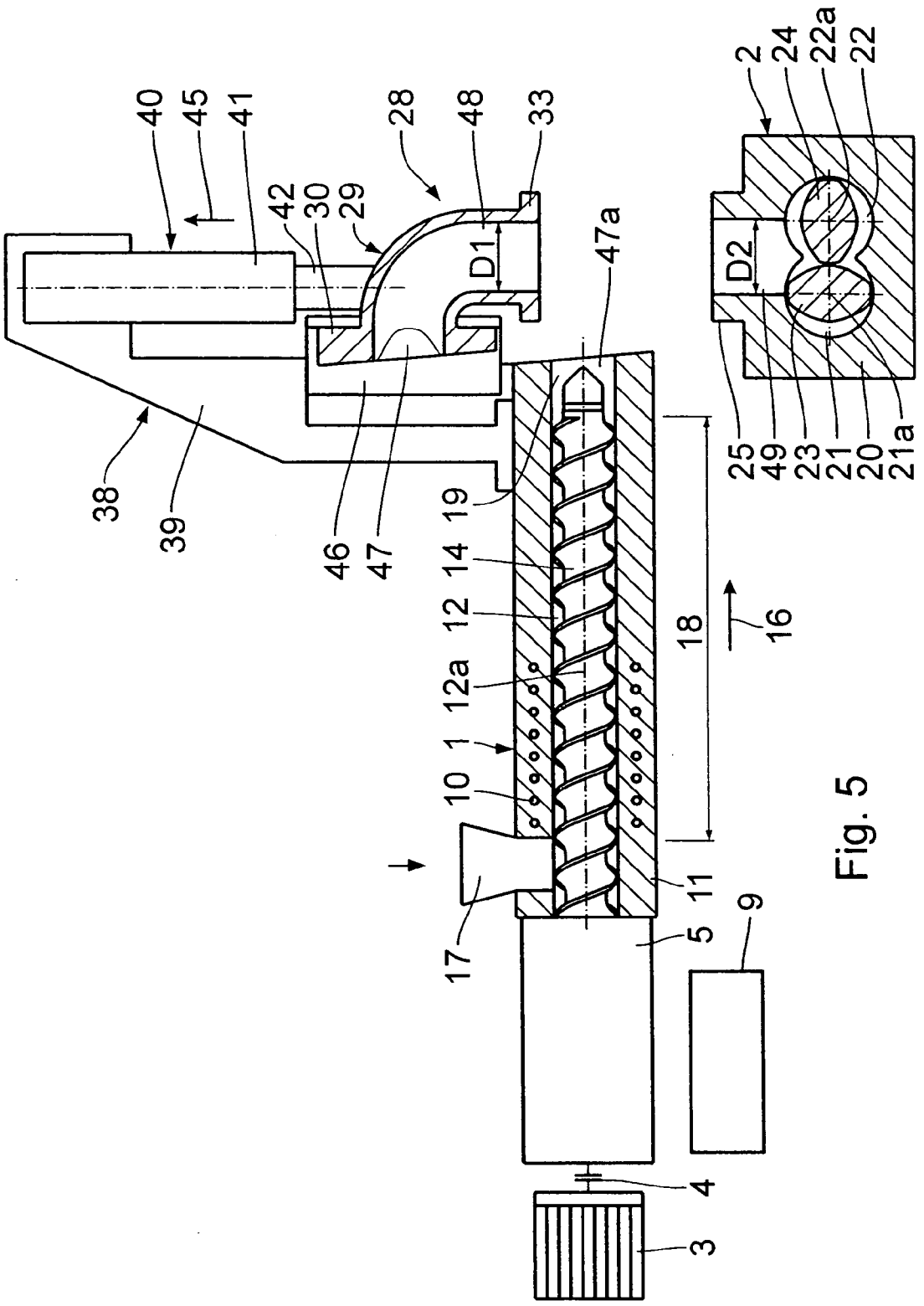
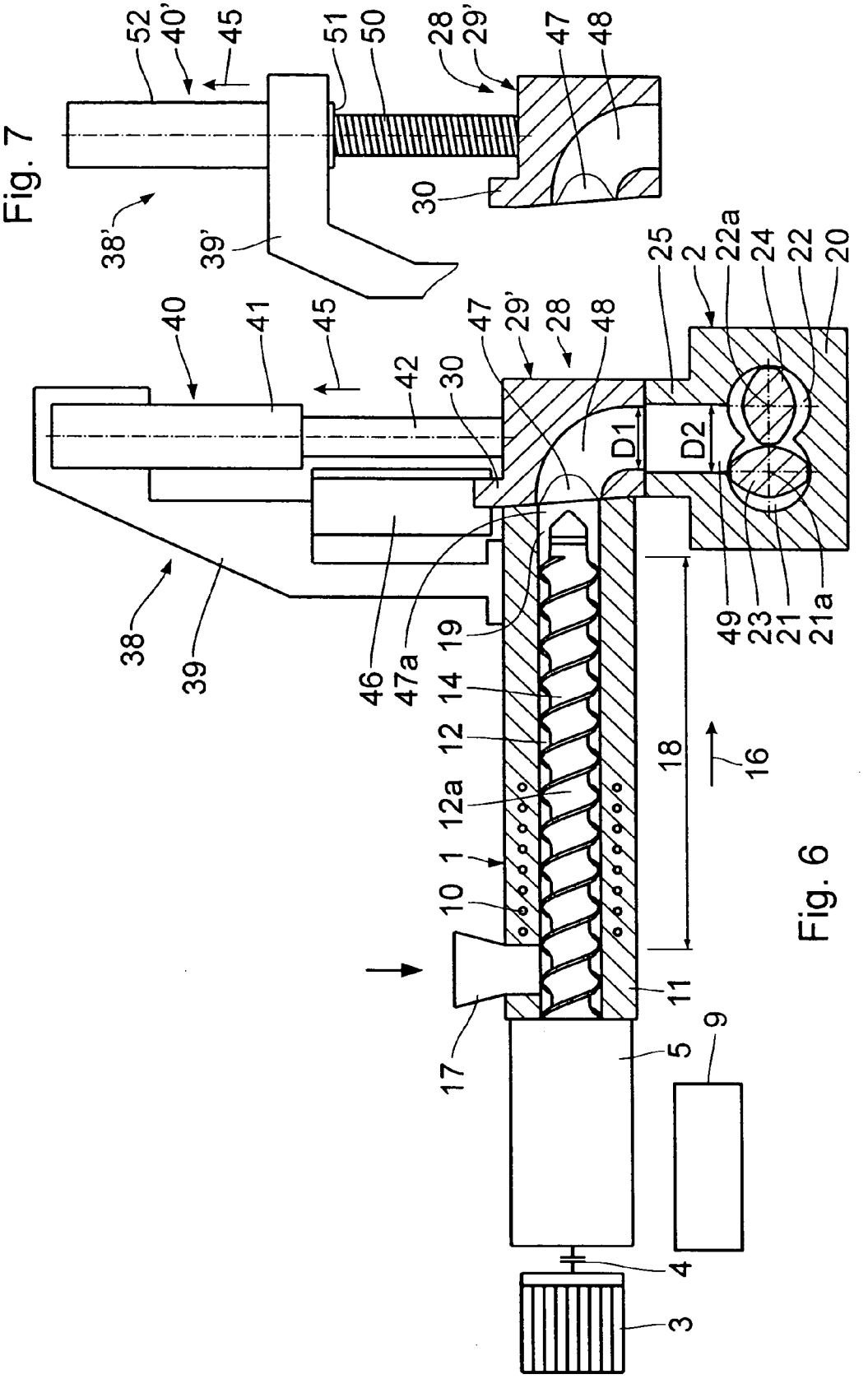

40
45
41
42
30
29
28
48
33
D1
47a
2
24
22a
22
D2
25
49
23
21
20
21a
38
39
46
47
19
14
12
12a
1
10
18
16
17
11
5
9
4
3

Fig. 5


52
40'
45
51
50
28
29'
47
48
30
38'
39'
Fig. 7
25
2
22a
24
22
20
40
41
45
47
29'
28
48
42
30
D1
D2
38
39
46
47a
19
14
12
12a
1
10
18
16
49
23
21
21a
17
11
5
9
4
3
Fig. 6

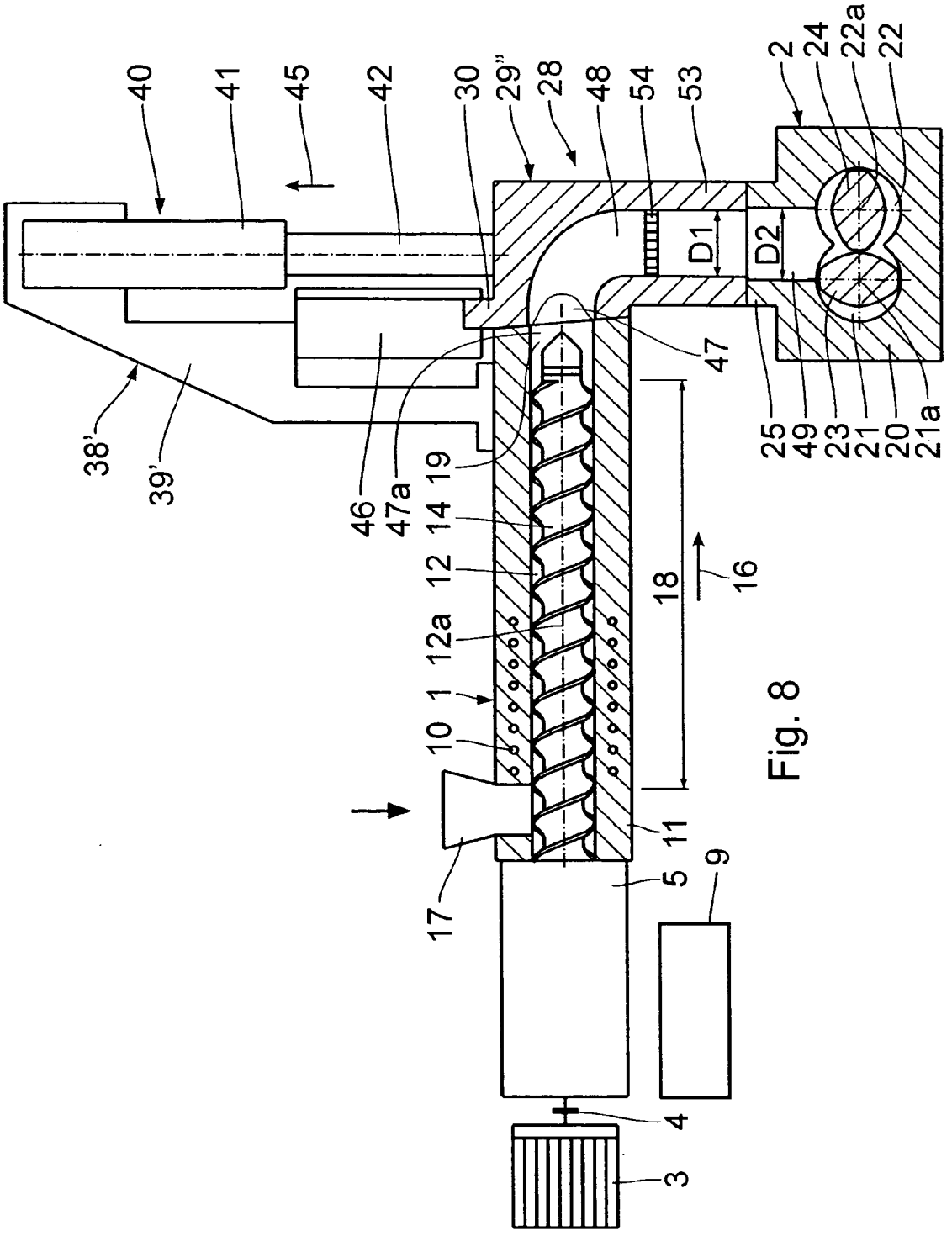

40
41
45
42
30
29"
28
48
54
53
2
24
22a
22
D1
D2
47
38'
39'
46
47a
19
14
12
12a
1
10
18
16
25
49
23
21
20
21a
11
5
9
17
4
3

Fig. 8

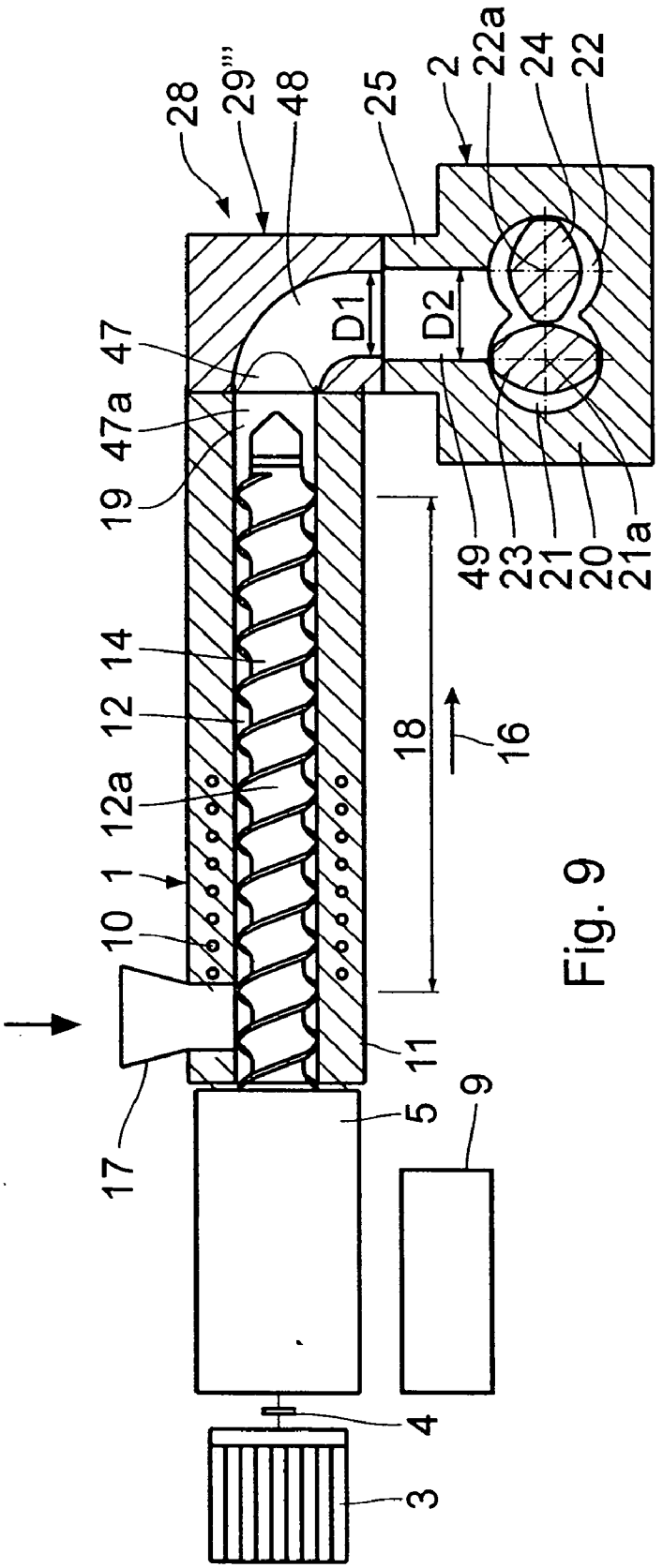

28
29'''
48
25
2
22a
24
22
D1
D2
47
47a
19
49
23
21
20
21a
14
12
12a
1
10
18
16
11
17
5
9
4
3

Fig. 9

Fig. 10

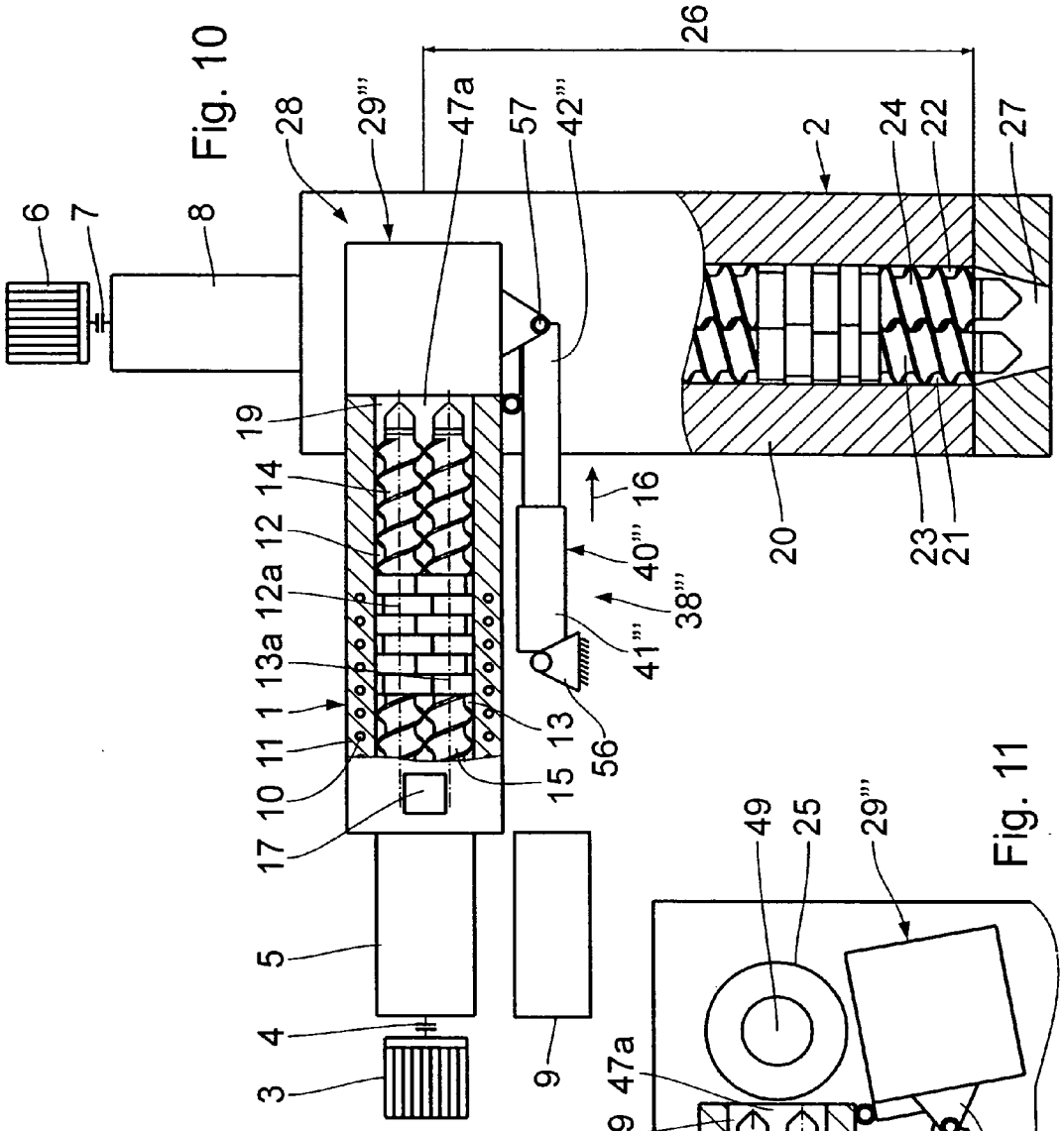

26
28
29'''
47a
57
42'''
2
24
22
27
6
7
8
19
14
12
12a
13a
1
11
10
17
5
4
3
9
15
13
56
16
40'''
38'''
41'''
20
23
21

Fig. 11

49
25
29'''
47a
19
14
12
12a
1
11
10
57
42'''
40'''
38'''
41'''
56

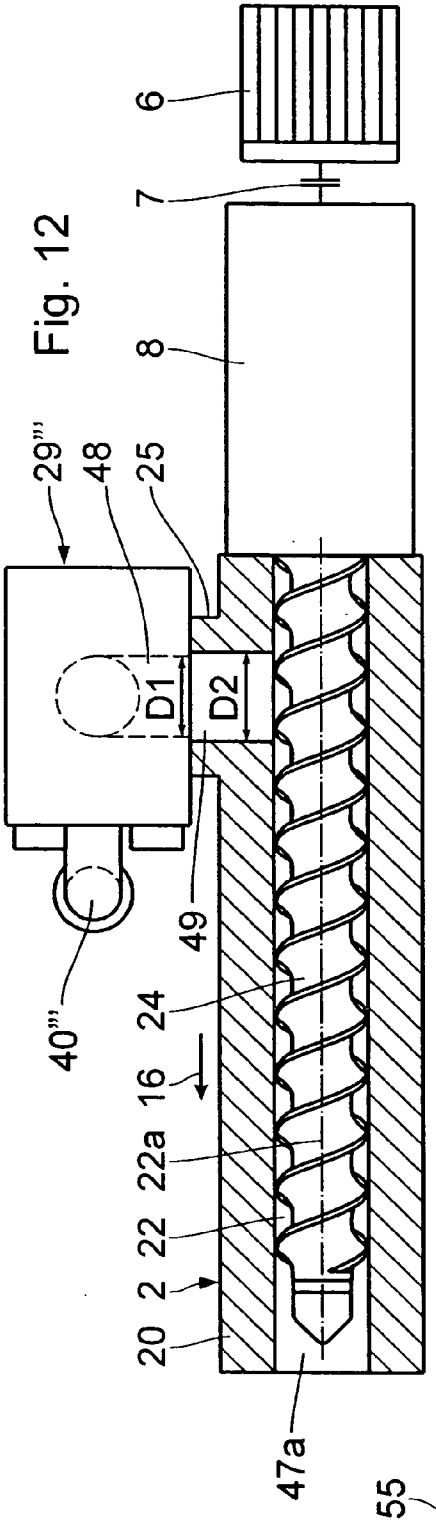


Fig. 12

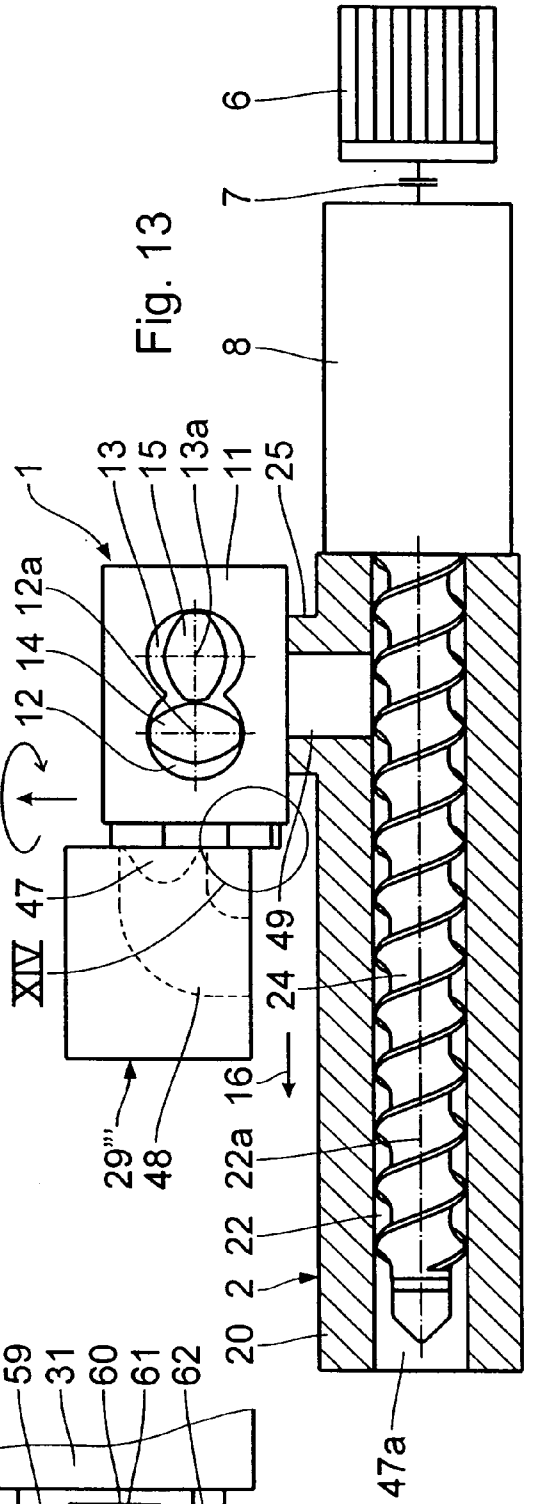


Fig. 13

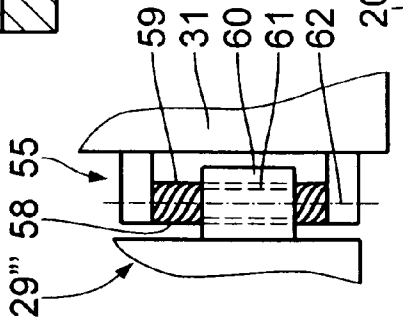


Fig. 14

MATERIAL PROCESSING PLANT

[0001] The invention relates to a material processing plant according to the pre-amble of claim **1**.

[0002] In particular in the processing of plastics, it is often reasonable to provide two or several successive extruders, each of which performing individual processing steps. For example, when plastic material is used in the form of powder, inlet and melting of the powder can take place in a first extruder. Homogenizing and pressure build-up then takes place in a second, down-stream extruder. Successive extruder arrangements of the generic type are known for example from EP 1 005 411 B1, U.S. Pat. No. 3,261,056 and DE 2 304 088 A. In the plants of the generic type known from literature and practice, the connecting parts, which often have a weight of several tons, are hard to remove and re-insert, with removal of the connecting parts being indispensable for the screw shafts of the first extruder to be pulled out. In practice, pulling out the screw shaft through the discharge zone is customary, because the other end is provided with the motor, coupling and transmission and pulling out the screw shaft there poses serious problems. The term 'materials' is to be understood as fundamentally free flowing materials that are treatable in screw-type extruding machines.

[0003] It is an object of the invention to develop a plant of the generic type in such a way that pulling the screw shaft or shafts of the first screw-type extruding machine is especially easy and time-saving.

[0004] According to the invention, this object is attained by the features of the characterizing part of claim **1**. The gist of the invention resides in that the link has been developed into an independent function group which, by means of a mover, can be transferred from its position of connection, in which the two screw-type extruding machines are interconnected, into an open position, in which the at least one screw bore lies bare so that the screw shaft or shafts of the first extruder can be pulled out customarily in the vicinity of the discharge zone.

[0005] Claims **2** and **3** reflect advantageous details involving the mover.

[0006] Claims **4** to **6** reflect a first advantageous embodiment of the guide of the link.

[0007] Claims **7** to **11** reflect another advantageous embodiment, specifying the mobility of the link in relation to a screw-type extruding machine.

[0008] Further features, advantages and details of the invention will become apparent from the ensuing description of several embodiments, taken in conjunction with the drawing, in which

[0009] FIG. **1** is a vertical sectional view of a first embodiment of a plant according to the invention, with the link in a position of connection;

[0010] FIG. **2** is a plan view, partially broken open, of the plant according the first embodiment;

[0011] FIG. **3** is an illustration of a detail III of FIG. **1**;

[0012] FIG. **4** is a horizontal partial view seen on the line IV-IV of FIG. **1**;

[0013] FIG. **5** is a vertical sectional view of the first embodiment of the plant according to the invention, with the link in an open position;

[0014] FIG. **6** is a vertical sectional view of a second embodiment of a plant according to the invention, with the link in a position of connection;

[0015] FIG. **7** is a partial view of a third embodiment, comprising a modified mover;

[0016] FIG. **8** is a vertical sectional view of a fourth embodiment of a plant according to the invention, with the link in a position of connection, the link having an additional function portion;

[0017] FIG. **9** is a vertical sectional view of a fifth embodiment of a plant according to the invention, with the link in a position of connection;

[0018] FIG. **10** is a plan view, partially broken open, of the plant according to the fifth embodiment, with the link in a position of connection;

[0019] FIG. **11** is a partial plan view of the plant according to the fifth embodiment, with the link in an open position;

[0020] FIG. **12** is a sectional view of the fifth embodiment plotted vertically through the second extruder, with the link in a position of connection;

[0021] FIG. **13** is an illustration according to FIG. **12**, with the link in an open position; and

[0022] FIG. **14** is a view of a detail XIV of FIG. **13**.

[0023] The first embodiment seen in FIGS. **1** to **5** comprises a first extruder **1** and a second extruder **2**. The first extruder **1** is disposed above the second extruder **2**. The first extruder **1** is actuated by a first motor **3** via a first coupling **4** and a first transmission **5**. The second extruder **2** is driven by a second motor **6** via a second coupling **7** and a second transmission **8**. Control of the motors **3** and **6** takes place by way of a control unit **9**.

[0024] The first extruder **1** comprises a casing **11** which is provided with a heating system **10** and has two first casing bores **12**, **13** with axes **12***a*, **13***a* that are parallel to one another, the casing bores **12**, **13** being disposed parallel to each other in approximately figure-eight-type interengagement. Two first screw shafts **14**, **15** are disposed in these casing bores **12**, **13**; they are coupled with the first transmission **5**. The screw shafts **14**, **15** are driven in the same or opposite directions. The first extruder **1** comprises a feed hopper **17** which is disposed downstream of the first transmission **5** as seen in a feed direction **16** and which is followed by a single or several processing zones **18**.

[0025] A discharge zone **19** is provided at the end of the first extruder **1**, discharge in a direction of the axes **12***a*, **13***a* taking place from the discharge zone **19**. Instead of two casing bores and, correspondingly, two screw shafts, it is just as well possible to have only a single bore or three and more bores and a corresponding number of screw shafts.

[0026] The second extruder **2** also comprises a casing **20** with a heating system, two casing bores **21**, **22** being disposed in the casing **20**, having axes **21***a*, **22***a* that are parallel to each other, and interengaging i.e., also defining a figure-eight-type cross-sectional shape. Two screw shafts **23**, **24** are disposed in the second casing bores **21**, **22**; they

are coupled with the second transmission **8** and drivable to rotate in the same or opposite directions. Subsequently to the second transmission **8**, the second extruder **2** comprises a feeder connection piece **25** which is followed by one or several processing zones **26** in the feed direction **16**. A discharge zone **27** is again provided at the end of the second extruder **2**.

[**0027**] It is true also for the second extruder **2** that only a single or more than two bores and a corresponding number of screw shafts can be provided. Also in the second extruder **2**, the screw shafts can be driven in the same or opposite directions.

[**0028**] A delivery zone **28** is provided between the first extruder **1** and the second extruder **2**, comprising a link **29** in the form of a pipe elbow. On the side turned towards the first extruder **1**, the link **29** has a connecting flange **30** which is fixed to the casing flange **31**, turned there-to, of the first casing by means of screws **32**. On the side turned towards the second extruder **2**, the link **29** also comprises a connecting flange **33**, the contact surface **34** of which bearing against a contact surface **35**, turned there-to, of the feeder connection piece **25**. The contact surface **35** is provided with recesses **36** where packings **37** are located which, in the non-loaded condition, project upwards beyond the contact surface **35**. The link **29** is not joined by screwing to the feeder connection piece **25**. The contact surfaces **34** and **35** bear tightly against one another due to thermal expansion during operation.

[**0029**] A mover **38** for the link **29** is disposed on the casing **11** of the first extruder **1**. It comprises a bracket-style holding device **39** that is mounted on the casing **11**. The holding device **39** supports a motion drive machanism **40** for the link **29**. This motion drive mechanism **40** can be a hydraulically operable piston-cylinder drive, the cylinder **41** of which is mounted on the holding device **39**, whereas its piston rod **42** is connected to the link **29**. In the first embodiment according to FIGS. **1** to **5**, the link **29** is lifted vertically upwards crosswise of the direction of the axes **12***a*, **13***a* and **21***a*, **22***a*, respectively, of the first extruder **1** and of the second extruder **2**. Consequently, elevating also takes place transversely to the contact surfaces **34**, **35** between the link **29** and the feeder connection piece **25**. For the connecting flange **30** to be as easy as possible to lift off casing flange **31**, the contact surfaces **43**, **44** of the two flanges **30**, **31** incline in relation to the vertical lift-off direction **45** so that they are released from one another directly upon start of the elevation process and, when set counter to the lift-off direction **45**, they take contact only at the very last moment. For reliable linear guidance of the link **29** in the lift-off direction **45** and in the opposite direction, guide rails **46** can be joined to the holding device **39** or the casing flange **31**, encompassing the connecting flange **30** and guiding it at least in the area where the link **29** is at least sectionally in congruence with the casing flange **31**.

[**0030**] As seen in FIG. **5**, the lift-off motion of the link **29** is sufficiently far for the first casing bores **12**, **13** to be definitely free in the vicinity of the discharge zone **19** so that the first screw shafts **14**, **15**, in the direction of their axes **12***a*, **13***a*, can be withdrawn freely from the first casing **11**.

[**0031**] At the respective places of transition, the overflow passages **47***a*, **47**, **48**, **49**, which are formed in the discharge zone **19** of the first extruder, the link **29** and the feeder connection piece **25**, do not possess any corners or edges that might project into the flow path. The cross-sectional shape of the over-flow passage **47***a* at the end of the first twin-shaft extruder **2** is figure-eight type. The cross-sectional area of the overflow passage **47***a* at the end of the extruder **1** is equal to, or less than, the cross-sectional area of the overflow passage **47** in the link **29**. A transition of this figure-eight type cross-sectional shape of the overflow passage **47** to the circular cross-sectional shape of the overflow passage **48** in the link **29** of a diameter D**1** is integrated in the link **29**. Moreover, the diameter D**2** of the overflow passage **49** in the feeder connection piece **25** equals or exceeds D**1**. D**1**≦D**2** applies. The same applies to cross-sections of extruders that have more than two screw shafts.

[**0032**] The second embodiment according to FIG. **6**, which is modified only slightly, differs from the first embodiment only in that the link **29'** is of block-type design, still having an elbowed overflow passage **48** without its external shape being tubular.

[**0033**] By alternative of the specified motion drive mechanism **40**, a motion drive mechanism **40'** in the form of a spindle drive can be used in the mover **38'** according to claim **7**, having a spindle **50** that acts on the link **29'**, the spindle **50** being guided in a spindle nut **51** that is rotarily disposed in the holding device **39'**. The spindle nut **51** is driven by a spindle-drive motor **52**.

[**0034**] The mover **38** or **38'**, respectively, needs not necessarily act in a vertical lift-off direction **45**; it can just as well act horizontally in the direction of the axes **21***a*, **22***a* of the second extruder **2** or spatially askew of the direction of the axes **12***a*, **13***a* of the first extruder **1**. However, the lift-off direction is preferred to work vertically, crosswise of the direction of the axes **12***a*, **13***a* of the first extruder.

[**0035**] The modified fourth embodiment according to FIG. **8** differs from the above embodiments in that the link **29"**, which is again of block-type design, is prolonged downwards towards the second extruder **2** by a function portion **53** where parts built in **54**, such as a strainer plate, a sieve, filter, static mixer or the like, are incorporated or can be incorporated. With these built-in function parts having to be accessible too, two functions, namely withdrawal of screws and exchange and/or maintenance of built-in parts **54**, are advantageously combined by only a singly mover device in this fourth embodiment.

[**0036**] The fifth embodiment according to FIGS. **9** to **14** again differs from the above embodiments by the design of the link **29'"**. Same as the link **29'**, it is again of block-style configuration. The link **29'"** is mounted on the casing **11** of the first extruder **1** by means of a pivoted connection mechanism **55** so that it can be pivoted from the sealed position of connection seen in FIG. **12** into an open position seen in FIG. **13**, as a result opening the first casing bores **12**, **13** so that the first screw shafts **14**, **15** can be extracted freely and without being impeded in the direction of the axes **12***a*, **13***a*.

[**0037**] A mover **38'"** comprises a motion drive mechanism **40'"** which may again be a hydraulically operable piston-cylinder drive, with the cylinder **41'"** being secured stationarily by means of a pivot bearing **56**, whereas the piston rod **42'"** is joined to the link **29'"** by means of a pivot joint **57**. For the link **29'"**, upon pivoting motion, to be lifted not only

off the casing **11** of the first extruder, but also off the feeder connection piece **25**, the pivoted connection mechanism **55** is a pivoted elevation-connection mechanism. To this end, it comprises a pivot **58** with a steeply pitched multiple thread **59**. The bearing sleeve **60** has a corresponding internal thread **61** so that the link **29'''** is displaced i.e., elevated in the present case, right at the beginning of the opening motion in the direction of the pivoting axis **62** of the pivoted connection mechanism **55**, with the link **29'''** being lifted off the feeder connection piece **25**. In the sealed position of connection according to FIGS. **9**, **10** and **12**, the link **29'''** is joined by screwing to the casing **11** of the first extruder **1** or the feeder connection piece **25** of the second extruder **2**. The screwing job can be dropped in certain cases, if for example there is only low pressure, or if the materials to be processed are of low viscosity, provided there are no built-in parts. In this case, the link **29'''** can be kept in the sealed position of connection by the motion drive mechanism **40'''**.

1. A material processing plant, comprising:

a first screw-type extruding machine, which has at least one casing bore and a screw shaft disposed therein,

a second screw-type extruding machine, which is disposed down-stream of the first screw-type extruding machine, and

a link, which connects the first screw-type extruding machine and the second screw-type extruding machined in a position of connection and which comprises an overflow passage;

wherein the link is movable in guided motion from the position of connection into an open position of release of the at least one casing bore; and

wherein a move, which acts on the link, is provided, performing the guided motion.

2. A plant according to claim 1, wherein the move, comprises a holding device and a motion drive mechanism.

3. A plant according to claim 2, wherein the holding device, is mounted on one of the screw-type extruding machines.

4. A plant according to claim 1, wherein the link is linearly displaceably in relation to the first screw-type extruding machine.

5. A plant according to claim 1, wherein the link is guided for displacement in relation to the first screw-type extruding machine by means of guide rails.

6. A plant according to claim 1, wherein the link is displaceable crosswise of the longitudinal direction of the first screw-type extruding machine.

7. A plant according to claim 1, wherein the link is pivotable from the position of connection into the open position.

8. A plant according to claim 7, wherein the link is articulated to one of the screw-type extruding machines by means of a pivoted connection mechanism.

9. A plant according to claim 8, wherein the pivoted connection mechanism is a pivoted elevation-connection mechanism.

10. A plant according to claim 9, wherein the pivoted connection mechanism comprises a pivot with a steeply pitched thread and a bearing sleeved which is disposed thereon and has an internal thread.

11. A plant according to claim 1, wherein the link comprises an additional function portion with built-in parts.

12. A plant according to claim 1, wherein only one contact surfaced between the link and one of the screw-type extruding machines is provided with packings.

13. A plant according to claim 1, wherein, being a second overflow passages of a diameter, the overflow passage which is formed in the link is connected to the first screw-type extruding machine by way of a first overflow passage and to the second screw-type extruding machine by way of a third overflow passageof a diameter; and

wherein D**1**≦D**2** applies to the relationship of D**1** to D**2**.

14. A plant according to claim 1, wherein the first screw-type extruding machine comprising two casing bores which intersect in figure-eight-type cross-sectional shape;

wherein, being a second overflow passage of circular cross-sectional shape and a diameter, the overflow passage which is formed in the link is connected to the first screw-type extruding machine by a first overflow passages; and

wherein the first overflow passage comprises a transition from a figure-eight-type cross-sectional shape to a circular cross-sectional shape.

15. A plant according to claim 14, wherein the first overflow passage is formed in the link.

16. A plant according to claim 1, wherein the mover is joined to the plant.

* * * * *